Frontiers in Computational Neuroscience 2014 vol.8 NSEP

Membrane current series monitoring: Essential reduction of data points to finite number of stable parameters

Nigmatullin R., Giniatullin R., Skorinkin A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2014 Nigmatullin, Giniatullin and Skorinkin. In traditional studies of changes in cell membrane potential or trans-membrane currents a large part of the recorded data presents "a pure noise." This noise results mainly from the random openings of membrane ionic channels. Different types of stationary or non-stationary noise analysis have been used in electrophysiological experiments for identification of channels kinetic states. But these methods have a limited power and often cannot answer to the main question of the experimental study: do external factors induce a significant change of channels kinetics? A new method suggested in the current study is based on the scaling properties of the beta-distribution function that allows reducing the series containing 200,000 and more data points to analysis of only 10-20 stable parameters. The following clusterization using the generalized Pearson correlation function allows taking into account the influence of an external factor and combine/separate different parameters of interest into a statistical cluster considering the influential parameter. This method which we call BRC (Beta distribution-Reduction-Clusterization) opens new possibilities in creation of a largely reduced database while extracting specific fingerprints of the long-term series. The BRC method was validated using patch clamp current recordings containing 250,000 data points obtained from the living cells and from open tip electrode. The numerical distinction between these two series in terms of the reduced parameters was obtained.

http://dx.doi.org/10.3389/fncom.2014.00120

Keywords

Detrended fluctuation analysis, Fluctuation spectroscopy based on beta-distribution, Membrane currents of neurons, Noise analysis, Sequence of the ranged amplitudes